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## **A GENDER PERSPECTIVE ON STUDENT QUESTIONING UPON THE TRANSITION TO HIGHER EDUCATION**

### **Abstract**

This paper refers to an ongoing PhD research (2011-2014) aimed at contributing to a better understanding of student questioning in the teaching, learning and assessment processes in higher education (HE), focusing on gender. The research is being conducted with first year chemistry students at the University of Aveiro in Portugal, and is intended to conceive and implement a number of strategies that promote student questioning in the different environments provided by the subject, such as classes and online interactions. The purpose of this particular paper is to bring clarity to significant literature published on the subject and to deepen our understanding of it, to be henceforward more capable of placing our original work in the context of existing literature.

### **The need to emphasize student questioning in HE**

*The communication paradigm change in transition to HE*

Research on science education highlights the need for new emphasis on teaching and learning, in particular in higher education. The transition to the tertiary level of education is one of the sharpest move students face during their academic lifetime. The admission to tertiary education is usually accompanied by an expansion on the size of the class, a growing physical distance between the students and the instructor and a dominant delivery of content by a didactic one-way lectures, which are perceived by students as impersonal and intimidating (DeBourgh, 2007). Such a learning environment can lead students to feel they are passive recipients of the instructor's lecture rather than active participants in a student-instructor interaction (Mayer *et al.*, 2009). Facing such a different setting from what they were used to, students tend to interact less with teachers, as they "feel reluctant to express an unpopular opinion and fear to be identified as uninformed or unprepared" (DeBourgh, 2007:78). This avoidance of verbal participation in classroom represents a limitation for the academic achievement of students (Neer, 1990). Because of this rejection of communication, students tend to raise fewer questions, and this can harm their academic success, as will be hereinafter stressed.

*Questioning under the spotlight of the first year*

In today's education, there is a call for the development of higher-order thinking skills and conceptual understanding (Lau & Yuen, 2010). Particularly Universities need to offer students a first year wherein their learning experiences assure the development of the necessary skills to empower them for lifelong learning (The European Commission, 2000; Johnston, 2010). Helping students to become lifelong learners implies the creation of the conditions for them to be able to update their own skills throughout their lifetimes.

Several authors hold that the development of the students' questioning skill has the potential to enhance several higher cognitive level capacities required for lifelong learning, such as critical analysis, problem solving and creative thinking (Cuccio-Schirripa & Steiner, 2000; Hofstein, Navon, Kipnis & Mamlok-Naaman, 2005; Teixeira-Dias, Pedrosa de Jesus, Souza, Almeida & Moreira, 2009).

Almeida, Teixeira-Dias and Martinho (2010), Pedrosa de Jesus, Teixeira-Dias and Watts (2003) and Zoller (1987) go further on, stating that the student questioning competency is not just one among others, but it is the most significant indicator of students most critical and highest order thinking. Developing such ability on students helps them "making connections to prior learning, promotes their engagement with their current understanding, makes them reflect about alternative ways of explaining phenomena, or ask why certain explanations are better than others" (Chin & Osborne, 2010:886), enhances active learning (Chin & Osborne, 2008; Chin & Osborne, 2010; Scholl, 2010) and can stimulate cognitive growth (Vogler, 2005). Moreover, "the ability to raise questions that involve higher order thinking is considered an important component of the scientific literacy" (Hofstein *et al*, 2005:802).

As the first year is a time of considerable cognitive growth and recognized importance in developing learning behavior (Harvey, Drew & Smith, 2006), before such benefits fostering a true questioning spirit of students from the first year on can result in an improvement on the quality of teaching and, accordingly, on the quality of learning (Pedrosa de Jesus, Almeida, Teixeira-Dias & Watts, 2007; Chin & Osborne, 2008; Hofstein *et al*, 2005). For this reason, the Boyer Commission's report (Boyer Commission on Education Undergraduates in the Research University, 1998) highlights the importance of promoting the questioning skill from the first year of university studies.

### **Questioning according to student's gender**

Several authors advocate that the gender of the student may be a factor in determining student conceptual understanding, academic performance and success in higher education (Lorezo, Crouch & Mazur, 2006; Dayioglu & Turut-Asik, 2007; Harvey, Drew & Smith, 2006). Thus, having in consideration the previously noticed widespread consensus supporting the great importance of students' questions in the process of knowledge construction, a deeper insight into the clarification of existing gender differences in student questioning patterns must be gained, in order to overcome found gender fragilities and, ultimately, add to the enhancement of learning in higher education.

A further appraisal of existing literature revealed that few studies have focused on gender differences on student questioning and even fewer have concentrated on higher education. Although there is a long-standing recognition of the existence of gender differences in verbal communication (Wood, 2009; Tannen, 1990), the few existing studies are not consensual.

On one hand Pearson *et al* (1995) stated that it is not clear which gender raises more questions. On the other hand, Jones *et al* (2000) observed that boys are less frightened than girls to pose questions.

Facing such a non-consensual issue, this study aspires to contribute to the enlightenment of this matter.

## HE Chemistry – an ungendered class

Recent data from the World Bank report on gender equality and development (The World Bank, 2011) highlight that currently girls participate equally (or more) than males at all education levels, including higher education. Nevertheless, women still face biases and barriers in particular fields of sciences (Wood, 2009). This is verified to such an extent that in most OECD countries the choice of HE discipline is highly gender dependent (OECD, 2006). While the proportion of women choosing advanced science and technology, or computing and engineering studies remains below 40% and 25%, respectively, women are systematically more numerous than men in life sciences (OECD, 2006). Lorezo, Crouch and Mazur (2005) also noticed this dissimilarity and added that physics comprises the largest gender disparity. The previously mentioned World Bank report also underlined that regardless of the income of the country, men continue to study engineering while women continue to learn how to be teachers (The World Bank, 2011).

Based on a significant review of existing literature Baram-Tsabari, Sethi, Bry and Yarden (2009) highlighted that despite male students prefer particular areas of science, such as physics and technology, girls are more interested in biology. The same study revealed that chemistry, on the other hand, is equally interesting to both genders. Thus, focusing on student questioning in chemistry classes, those aspects related to the students' interest on the subject could be overlooked.

Besides its gender blindness, chemistry is a particularly encouraging area of science to study, because of its impact and centrality in today's world, which brings about a contextualized teaching referred to everyday situations. This specificity of chemistry encourages and fosters interaction, discussion and debate between the teacher and the students. It is, thus, a privileged subject to develop diversified teaching, learning and assessment strategies that promote an active learning (Teixeira-Dias *et al.*, 2009).

## Students' online questioning according to gender

### *Gender differences in students' online interactions*

Students who participate in online activities are more likely to be higher achievers in their educational performance (Davies & Graff, 2005; Sivapalan & Cregan, 2005).

Still, in spite of gender differences in attitudes towards technology, online communication style (Savicki, Kelley & Oesterreich, 1999), participation pattern (Penny, 2011) and computer access and application (Adamus *et al.*, 2009) have long been recognized, the juxtaposition of such studies results inconclusive. Some researchers claim that women are disadvantaged in online courses (Blum, 1999; McSporran & Young, 2001; Braten & Stromso, 2006), while others defend that males are those who are underprivileged (Young & McSporran, 2001). Braten and Stromso (2006) noticed that "males reported higher levels of participation in Internet-based communication activities than females, and females reported higher levels of strategy use when learning from conventional printed texts than males" (p. 1027).

Further insight is, thus, needed for this area of study, as a lack of agreement is verified. Researchers on science education are, hence, "challenged to identify the

characteristics that make learning environments friendly to both male and female students, and encourage participation and enhance opportunities of success for all” (Gunn, McSporran, Macleod & French, 2003:24).

#### *Students’ web-based questioning*

In light of the numerous advantageous features of network technology (independence of time, place, device and platform, vast storage capacity, high processing speed, multimedia facilities, instant data retrieval and management, customizable design, ease of updating and anonymity), “there has been a growing number of projects focused on the design and development of web-based student question-generation learning systems” (Yu, 2011:485), many of which in higher education.

In a study conducted with first year chemistry students, it was noticed that “giving students the possibility to pose their questions through online systems allowed them to ruminate on their questions, to undertake reading and tackle assignments, and then to ask questions in ‘down-time’ when away from the formal situation” (Teixeira-Dias, Pedrosa de Jesus, Neri de Souza & Watts, 2005:1136).

Results provided by Barak and Rafaeli (2004) also sustain that web-based activities, which require students to generate questions, “can serve as both learning and assessment enhancers in higher education by promoting active learning, constructive criticism and knowledge sharing” (p. 84).

Wilson (2004) highlights that when students were asked to write exam questions and evaluate other student’s responses they “improved their ability to communicate, critical thinking skills, ability to integrate facts, and motivation to do additional readings” (p. 89).

Several studies support that students themselves also recognize the benefits of online question generation systems. Yu (2009) carried a research under the premise that student question generation activities in a large class are more timely, convenient, individualized, unthreatening and logistically feasible, if conducted using computer network technology. To meet his goals, he developed an online student question generation learning system to foster student questioning and concluded that the exploitation of the affordances of computer and networked technologies is perceived as providing high levels of support for student question generation activities. Similarly, Yu, Liu and Chan (2005) remarked the importance of fostering students questioning through multimedia tools available online and noticed that by enabling students to compose questions, and criticize and adapt other students’ questions, they perceived their learning as more motivating and cognitively-enhanced.

#### *Students’ web-based questioning according to gender*

Few studies focusing on the questioning profiles of boys and girls have compared differences in online and in class settings. In an attempt to identify the existing barriers to an equitable participation of both genders, either in class or online, Blum (1999) undertook an investigation to compare the questioning patterns of boys and girls. With this study Blum concluded that girls ask more questions than boys in class, while boys ask more and answer more questions than girls in online environments.

## Concluding remarks

Regarding non-consensual gender differences in communication patterns, either in-class or online, and considering the great importance of students questions in the process of knowledge construction, it is important to investigate and characterize students questioning profiles according to their gender and to the learning environment in which they are immerse (such as classes or online environments).

As educational institutions have the capacity to “produce or reinforce gender bias and stereotypes, they can also resist to those biases and raise other values and attitudes” (Vianna & Ridenti, 1998:103). It is, thus, expected that this investigation will contribute to the clarification of gender differences on student questioning among teachers so that they are more well-informed when making decisions regarding how to facilitate instruction - either in-class or online - and how to minimize gender-related opportunity disparities. Simultaneously strategies will be developed to foster questioning, while promoting gender equity among students.

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## References

- Adamus, T., Kerres, M., Getto, B. & Engelhardt, N. (2009). Gender and e-tutoring – A concept for gender sensitive e-tutor training programs. *5th European Symposium on Gender and ICT Digital Cultures: Participation – Empowerment – Diversity*, March 5-7, 2009 – University of Bremen. Url: [http://www.informatik.uni-bremen.de/soteg/gict2009/proceedings/GICT2009\\_Adamus.pdf](http://www.informatik.uni-bremen.de/soteg/gict2009/proceedings/GICT2009_Adamus.pdf) (accessed in 28<sup>th</sup> February 2012).
- Almeida, P., Teixeira-Dias, J. J. & Martinho, M. (2010). Teaching and Learning Chemistry: a new approach at the University of Aveiro, in Portugal. In N. Popov, C. Wolhuter, B. Leutwyler, M. Mihova & J. Ogunleye (Eds.), *Comparative Education, Teacher Training, Education Policy, School Leadership and Social Inclusion* (pp. 357-362). Sofia, Bureau for Educational Services.
- Barak, M. & Rafaeli, S. (2004). On-line question-posing and peer-assessment as means for web-based knowledge sharing in learning. *International Journal of Human-Computer Studies*, 61(1), 84–103.
- Baram-Tsabari, A., Sethi R. J., Bry L. & Yarden, A. (2009). Asking scientists: A decade of questions analyzed by age, gender, country and time. *Science Education*, 93(1), 131-160.
- Blum, K. (1999). Gender Differences in Asynchronous Learning in Higher Education: Learning Styles, Participation Barriers and Communication Patters. *JALN*, 3(1).
- Boyer Commission on Education Undergraduates in the Research University (1998). *Reinventing undergraduate education: a blueprint for America's Research Universities*. Url: [http://naples.cc.sunysb.edu/pres/boyer.nsf/673918d46fbf653e852565ec0056ff3e/d955b61ffddd590a852565ec005717ae/\\$FILE/boyer.pdf](http://naples.cc.sunysb.edu/pres/boyer.nsf/673918d46fbf653e852565ec0056ff3e/d955b61ffddd590a852565ec005717ae/$FILE/boyer.pdf) (accessed in 3rd March 2012).
- Bråten, I. & Strømso, H. I. (2006). Epistemological beliefs, interest, and gender as predictors of Internet-based learning activities. *Computers in Human Behavior*, 22, 1027–1042.
- Chin, C. & Osborne, J. (2008). Students questions: a potential resource for teaching and learning science. *Studies in Science Education*, 44(1), 1-39.

- Chin, C. & Osborne, J. (2010). Students' questions and discursive interaction: Their impact on argumentation during collaborative group discussions in science. *Journal of Research in Science Teaching*, 47: 883–908.
- Cuccio-Schirripa, S. & Steiner, H. (2000). Enhancement and analysis of science question level for middle students. *Journal of Research in Science Teaching*, 37(2), 210-224.
- Davies, J. & Graff, M. O. (2005). Performance in e-learning: Online participation and student grades. *British Journal of Educational Technology*, 36(4), 657-663.
- Dayioglu, M. & Turut-Asik, S. (2007). Gender differences in academic performance in a large public university in Turkey. *Higher Education*, 53, 255-277.
- DeBourgh, G. A. (2008). Use of classroom "clickers" to promote acquisition of advanced reasoning skills. *Nurse Education in Practice*, 8(2), 76-87.
- Gunn, C., McSporran, M., Macleod, H. & French, S. (2003). Dominant or Different? Gender Issues in Computer Supported Learning. *Journal of Asynchronous Learning Networks*, 7(1), 14-30.
- Harvey, L., Drew, S. & Smith, M. (2006). The First-year Experience: A Review of Literature for the Higher Education Academy. Url: [http://www.heacademy.ac.uk/research/Harvey\\_Drew\\_Smith.pdf](http://www.heacademy.ac.uk/research/Harvey_Drew_Smith.pdf) (accessed in 1st March 2012).
- Hofstein, A., Navon, O., Kipnis, M. & Mamlok-Naaman, R. (2005). Developing students ability to ask more and better questions resulting from inquiry-type chemistry laboratories. *Journal of Research in Science Teaching*, 42(7), 791-806.
- Johnston, B. (2010). *The First Year at University: Teaching Students in Transition*. The Society of Research into Higher Education and Open University Press, Maidenhead, UK.
- Jones, M. G., Howe, A. & Rua, M. (2000). Gender differences in students' experiences, interests, and attitudes toward science and scientists. *Science Education*, 84, 180-192.
- Lau, W. & Yuen, A. (2010). Promoting Conceptual Change of Learning Sorting Algorithm through the Diagnosis of Mental Models: The Effects of Gender and Learning Styles. *Computers & Education*, no 1 (vol. 54), 275-288.
- Lorenzo, M., Crouch, C. & Mazur, E. (2006). Reducing the gender gap in the physics classroom. *American Journal of Physics*, 74 (2), 118-122.
- Mayer, R. E., Stull, A., DeLeeuw, K., Almeroth, K., Bimber, B., Chun, D., Bulger, M., Campbell, J., Knight, A. & Zhang, H. (2009). Clickers in college classrooms: Fostering learning with questioning methods in large lecture classes. *Contemporary Educational Psychology*, 34(1), 51-57.
- McSporran, M. & Young, S. (2001). Does gender matter in online learning? *Association of Learning Technology Journal*, 9(2), 2-17.
- Neer, M. R. (1990). *Instructor communication behavior as a factor influencing the class participation of classroom communication apprehensives*. Paper presented at the Annual Meeting of the Speech Communication Association, Chicago.
- OECD (2006). Evolution of Student Interest in Science and Technology Studies Policy Report.
- Pearson, J., West, R. & Turner, L. (1995). *Gender and Communication* (3rd ed.). Dubuque, Brown & Benchmark Publishers.
- Pedrosa de Jesus, H., Teixeira-Dias, J. J. C. & Watts, M. (2003). Questions of Chemistry. *International Journal of Science Education*, 25(8), 1015-1034.
- Pedrosa de Jesus, H., Almeida, P., Teixeira-Dias, J. J. & Watts, M. (2007). Where learners' questions meet modes of teaching. *Research in Education*, 78, 1-20.
- Penny, K. (2011). Factors that Influence Student E-learning Participation in a UK Higher Education Institution. *Interdisciplinary Journal of E-Learning and Learning Objects*, 7, 81-95.

- Savicki, V., Kelley, M. & Oesterreich, E. (1999). Judgments of gender in computer mediated communication. *Computers in Human Behavior*, 15, 1-10.
- Scholl, R. (2010). The Question Quadrant: A stimulus for a negotiated curriculum. *Primary & Middle Years Educator*, 8(2), 3-16.
- Sivapalan, S. & Cregan, P. (2005). Value of online resources for learning by distance education. *CAL- laborate*, 14, 23-27.
- Tannen, D. (1990). *You just don't understand: Women and men in conversation*. New York: Ballantine.
- Teixeira-Dias, J. J. C., Pedrosa de Jesus, H., Neri de Souza, F. & Watts, D. M. (2005). Teaching for Quality Learning in Chemistry. *International Journal of Science Education*, 27(9), 1123-1137.
- Teixeira-Dias, J., Pedrosa de Jesus, H., Souza, F., Almeida, P. & Moreira, A. (2009). Questões de estudantes universitários no primeiro ano: Como promover a aprendizagem activa em Química. In Huet, I., Costa, N., Tavares, J. & Baptista, A. (Eds.), *Docência no ensino superior – partilha de boas práticas* (pp. 61-78). Universidade de Aveiro.
- The European Commission. (2010). Commission staff working paper: A memorandum on lifelong learning. Url: [www.see-educoop.net/education\\_in/pdf/lifelong-oth-enl-t02.pdf](http://www.see-educoop.net/education_in/pdf/lifelong-oth-enl-t02.pdf) (accessed in 6th March 2012).
- The World Bank (2011). *World development report 2012 – gender equality and development*. Washington DC.
- Vianna, C. & Ridenti, S. (1998). Relações de género e escola: das diferenças ao preconceito. In Summus Editorial Ltda.
- Vogler, K. E. (2005). Improve Your Verbal Questioning. *The Clearing House*, 79 (2), 98-103.
- Wilson, E. V. (2004). ExamNet asynchronous learning network: augmenting face-to-face courses with student-developed exam questions. *Computers & Education*, 42(1), 87-107.
- Wood, J. T. (2009). *Gendered lives: Communication, gender, and culture* (8th ed.). Belmont, Wadsworth.
- Young, S. & McSparran, M. (2001). Confident men - successful women: Gender differences in online Learning. In C. Montgomerie & J. Viteli (Eds.), *Proceedings of EdMedia 2001 Conference* (pp. 2110-2112), Chesapeake, VA: AACE.
- Yu, F., Liu, Y. & Chan, T. (2005). A web-based learning system for question-posing and peer assessment. *Innovations in Education and Teaching International*, 42(4), pp. 337-348.
- Yu, F. (2009). Scaffolding student-generated questions: Design and development of a customizable online learning system. *Computers in Human Behavior*, 25, 1129-1138.
- Yu, F. (2011). Multiple Peer-Assessment Modes to Augment Online Student Question-Generation Processes. *Computers & Education*, 56 (2), 484-494.
- Zoller, U. (1987). The fostering of question - asking capability: A meaningful aspect of problem-solving in chemistry. *Journal of Chemical Education*, 64, 510-512.

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